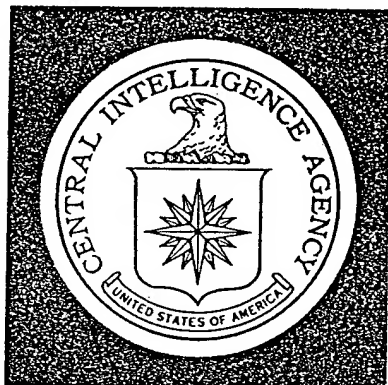


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DIRECTORATE OF
INTELLIGENCE

CIA HISTORICAL REVIEW PROGRAM
RELEASE IN FULL 1998

Intelligence Report

*Estimating Soviet Spending for Military
Research and Development*

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SR IR 71-15
September 1971

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
September 1971

INTELLIGENCE REPORT

Estimating Soviet Spending for Military
Research and Development

Foreword

Unlike the United States, the Soviet Union publishes no breakdown of its military budget or expenditures. Soviet outlays for military research and development are funded through a variety of budget accounts along with allocations for other items, in such a fashion as to obscure the amounts. The measurement of Soviet expenditures for military research and development therefore poses a complex problem of estimation, requiring the evaluation of direct and indirect data from Soviet budget announcements and related literature as well as other evidence on Soviet military and scientific activities available to the West.

The costing of military RDT&E (research, development, testing, and evaluation) is further complicated by the nature of these activities. To develop its estimates of Soviet expenditures for deployed forces the Office of Strategic Research employs a technique of direct costing. That is, judgments based chiefly on what is observable as to the numbers of Soviet weapons and forces in being are multiplied by estimates of what these weapons and forces would cost in rubles and in dollars. By contrast, a large part of the Soviet R&D process--almost all basic research and a great deal of applied research--is not observable directly and cannot be associated with a specific finished product. As the direct costing technique

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is therefore inadequate for costing military RDT&E, other methods--described in this intelligence report--must be used.

One purpose of the report is to present expenditure estimates for the years 1960 to 1970. An equally important purpose is to provide a description of the basic data and the estimative process so that the reader can appreciate the nature of these estimates and their inherent limitations.

The reader should also note that a distinction must be drawn between two conceptual problems in the assessment of overall Soviet military RDT&E activities. One is the problem of estimating the amount of resources--expressed in rubles and dollar equivalents--expended on these activities. The other treats the effectiveness of these activities in accomplishing Soviet military RDT&E objectives. This report is concerned entirely with problems of the first kind--estimating Soviet military RDT&E expenditures and dollar valuations of Soviet military RDT&E activities.

A summary of this report begins on page 5.

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Summary

Official Soviet announcements on annual expenditures for "science" are believed to cover essentially all outlays for military RDT&E, civil R&D, and space programs. The Soviet announcements do not provide direct information on the utilization of these funds, however, and the overall spending figures must be analyzed--using earlier, more detailed Soviet breakdowns of "science" activities together with direct costing of space programs and some fragmentary information on other aspects of spending--to derive estimates of expenditure series for military RDT&E, civil R&D, and space programs.

These estimates reflect a vigorous Soviet "scientific" program during the past decade. Total outlays increased on the average by about 10 percent per year, from about 4 billion rubles (\$7.8 billion) in 1960 to about 11 billion rubles (nearly \$21 billion) in 1970.

About 58 percent of the total Soviet R&D and space effort in 1960 went for military RDT&E programs, but by the late Sixties the military share had declined to about 45 percent. The main reason for this shift was the increasing financial importance of the Soviet space program. Still a fledgling venture in 1960, the Soviet space effort then used only about 6 percent of total R&D funds. By the late Sixties this figure had risen to 25 percent of the total. Estimated outlays for civil R&D represented 36 percent of total "science" funding in 1960. The share of outlays for civil R&D declined slowly to 30 percent in 1963, and has since remained at about that level.

Although military RDT&E funding has declined as a share of total "science" outlays, it has steadily increased in relation to total *defense* spending. In 1960 military RDT&E expenditures of about 2.4

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billion rubles (\$4.8 billion) were about 16 percent of total military outlays. By 1970 they had increased to about 4.9 billion rubles (\$9.8 billion), some 23 percent of all Soviet military costs.

These estimates of Soviet spending for military RDT&E must be viewed with some caution. First, the basic data come from Soviet publications. The validity of the resulting estimates therefore depends both upon the accuracy of Soviet financial accounting and a correct interpretation of the published information. The use of data pertaining to the Fifties as a primary basis for splitting subsequent Soviet R&D effort into its components is an additional source of uncertainty. Finally, the transition from rubles to dollars and dollars to rubles presents a number of theoretical complexities as well as practical problems. The estimates of military RDT&E are more uncertain for recent years. For 1970, especially, they should be regarded as preliminary and subject to change. The large increase in funding indicated is not yet corroborated by any direct observations.

To test the reasonableness and internal consistency of the estimates derived from financial data published by the Soviets, they have been correlated with other indicators of Soviet R&D activity such as scientific employment, numbers of scientific research institutes, and a calculated scientific wage bill. These statistical checks all provide general support to the estimated trends in total Soviet R&D spending.

In spite of uncertainties and potential for error, it is believed--and the cross-checks tend to support this belief--that on balance the estimates presented in this report are reasonably accurate representations of the trends and levels of Soviet efforts, although less confidence can be attached to the detailed breakdown among military RDT&E, civil R&D, and space than to the total.

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There is, of course, no clear line of demarcation between research and development and the preparatory stages of series production, nor between innovative design in new product development and production design directed at modifications of existing products. In these grey areas R&D accounting is as often as not done as a matter of convention and convenience rather than according to strict accounting definitions--this is true in the US as well as in the USSR. For all these reasons, international comparisons of R&D expenditures are subject to even greater uncertainty than exists for measures of other economic activity.

Finally, it is important to note that the capabilities and limitations of hardware, the relative technological positions of the USSR and the US, and the future threat to the US of the Soviet military as a result of their military RDT&E effort cannot be determined solely on the basis of expenditure estimates. Such estimates provide at best a good appreciation of the level of effort and its change over time, but they cannot in themselves directly relate this effort to relative strength or weakness.

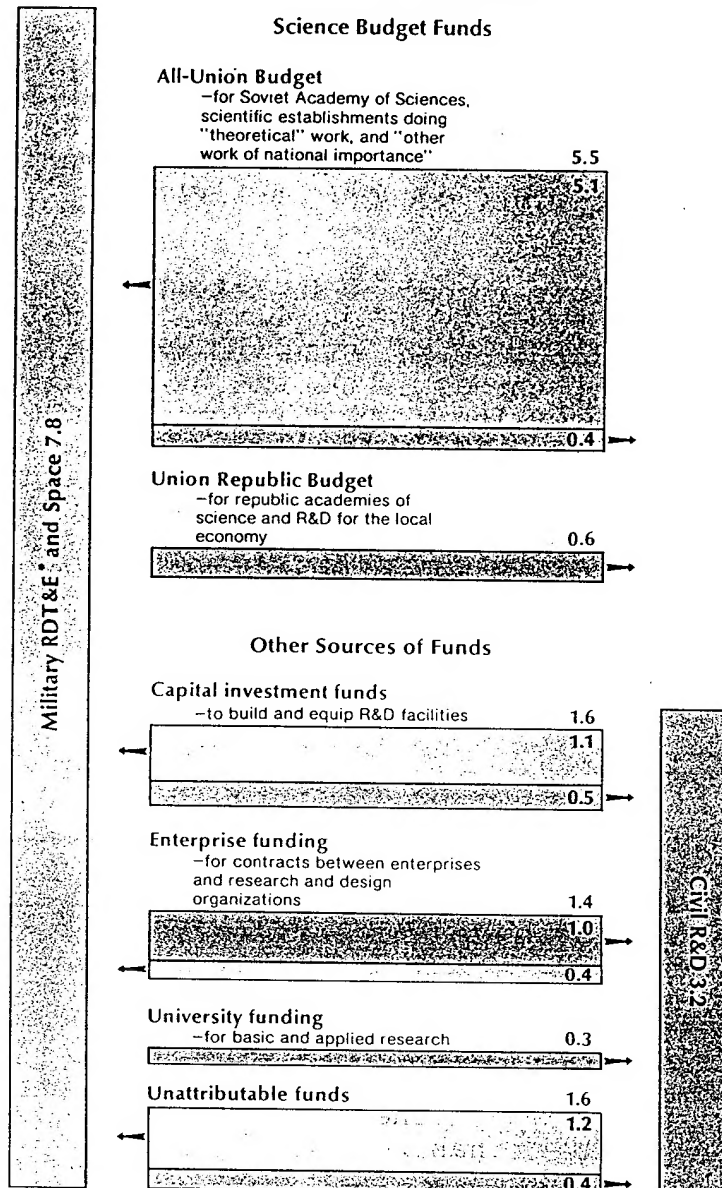
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Estimated Sources and Disposition of Soviet Funds for R&D and Space, 1970

(Figures are billions of 1968 rubles)

Total R&D funding: 11 billion rubles



• Covers all military systems RDT&E including military space systems and all nuclear energy RDT&E. Outlays for members of active military forces assigned to RDT&E activities as well as for civilian personnel employed in such activities are included.

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Discussion

Estimative Methodology

Sources of Funds

Because of the secrecy surrounding much of Soviet scientific activity and the inherent complexity of making economic assessments of R&D, it is difficult for intelligence analysts to judge precisely the level of Soviet scientific activity or its distribution among military, civil, and space projects.

The Soviets provide data identified as "total expenditures for science from the [state] budget and other sources." Official Soviet writings indicate that this figure includes funding for civil and military R&D activity as well as for the space program.

The Soviet state budget is composed of six major elements:

- Financing the National Economy
(basically investment funds)
- Social-Cultural Measures
- Defense
- Administration
- Loan Services
- Residual and Reserve Funds of the Councils
of Ministers.

The Social-Cultural Measures account is further broken down into allocations for Enlightenment (Education and the Arts), "Science," and other items (culture, health, and social welfare). Finally, the "Science" account is divided between All-Union expenditures (spending at the national level) and Union Republic expenditures (spending at the republic or local levels). The Soviets have not published a breakdown of the "Science" account between All-Union and the Union Republic expenditures, however, since 1965. The distribution in 1965 between these two accounts has been used to allocate their shares since then.

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The largest single source of funds for R&D and space is the All-Union "science" category of the state budget, which accounts for about one-half of the total. Capital investment in R&D and space facilities--funded from another category of the state budget--accounts for about 15 percent of total "science" expenditures. Other funds for "science" are provided by individual enterprises, universities, and ministries, including probably the Ministry of Defense. Expenditures by these other sources are not reported but rather appear as a residual termed "funds of enterprises and other organizations." Estimates of expenditures by universities and enterprises have been made by extrapolation from information available for certain years. This procedure leaves a sizable share of "science" funds unattributed to a specific source. This unattributable category may largely represent funds from the Defense budget.

Components of R&D Spending

The Soviets do not publish a breakdown of their "science" expenditures among civil R&D, military RDT&E (research, development, testing, and evaluation), and their space program. In 1958, however, they did publish a detailed resource breakdown--for example, wages and salaries, instruments, books, etc.--of expenditures for the 1950-1957 period under the All-Union and the Union Republic "science" budgets. The budgets of the Union Republics--which are devoted to developing "local industry" (essentially civil R&D)--itemized expenditures about equal to their announced totals.

The sum of the detailed cost for the All-Union budget, however, did not equal the announced budget figure. It left unexplained a large annual residual that grew steadily over the 1950-1957 period. Analysis of the official expenditure data and pertinent economic literature suggests that this residual is the major source of funds for those activities considered sensitive by the Soviets--military RDT&E, nuclear energy R&D, and the space program. Soviet publications, for example, have identified the All-Union budget allocation for "science" as a source of funds for "work of national importance" and associate "science" budgets expenditures with ballistic missile development and the space program. The Office of Strategic Research there-

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fore considers this residual as military RDT&E and space spending, or "classified" expenditures.

The Soviets have not published an itemized All-Union "science" budget since 1958. For this reason the Office of Strategic Research has used the trend of the period 1950-1957 as the basis for estimating "classified" budget expenditures for "science" since 1957. Both the residual and the itemized portion increased between 1950 and 1957, but the residual became a larger share. In 1950 the residual accounted for about 57 percent of the total and by 1957 it had increased to almost 75 percent.

To estimate the "classified" residual for the years after 1957, the growing share of the 1950-1957 period was extrapolated but only until 1964, when it reached about 90 percent. Some nondefense R&D activity that is of "national importance," and therefore funded by the All-Union "science" budget, almost certainly occurs. For the years after 1964, the methodology used maintains the estimated share for the "classified" residual at 90 percent of the All-Union "science" budget.

In addition to allocating all of the "classified" residual to military RDT&E and space spending, the estimative methodology allocates one-third of the remaining portion of the All-Union "science" budget to military RDT&E and space spending. This allocation is based on the judgment that some of the research financed by these funds--for example, development work of a general nature on electronic components--contributes directly to military and space programs.

The estimative methodology allocates the other types of Soviet R&D funds between civil programs on the one hand and military RDT&E and space on the other as follows:

-- Enterprise "science" expenditures are allocated on the basis of the relative shares of civilian and military production in the total output of machinery and equipment. During the Sixties about 25 percent of output was allocated to defense and 75 percent to civilian uses. It can be assumed that a similar portion of the enterprise funds for "science" were provided by the industries contributing to this pattern of production--75 percent for civil R&D and 25 percent for military RDT&E and the space program.

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-- All university funds devoted to R&D activity in the USSR are believed to be for civil purposes. What little military R&D these institutions may perform is probably done under contract and hence the financing would probably originate from some other funds.

-- Capital investment funds for "science" and unattributable funds presumably support all R&D activities. They are consequently apportioned on the same general basis as the civil-military split estimated for "science" budget funds, enterprise funds, and university funds considered as a whole--that is, one-quarter civil and three-quarters military and space.

As a result of this procedure, it is estimated that about 30 percent of total Soviet "science" outlays goes to civil R&D and 70 percent to military RDT&E and space for the period 1960-1970. These shares should be regarded only as approximations because of the uncertainties in the estimative procedure.

Space Expenditures

The next step in the process of isolating Soviet military RDT&E spending is to estimate expenditures for the Soviet space program. In this case the direct costing approach is used. Enough detailed knowledge of the Soviet space effort is available from direct observation to permit an assessment of what each individual Soviet space program would cost if it were undertaken in the US. The sum of these program costs plus allowances based on US analogy for such nonprogram cost elements as administration and advanced research form the basis of the estimate of total Soviet space expenditures. This estimate of space expenditures conceptually covers the full range of Soviet space activities.

There is no information which suggests that the Soviets distinguish--in funding or institutional terms--between space programs related to military requirements

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and those related to civil objectives. The estimate of total Soviet space spending, however, has been allocated between military and civil for comparison with US programs. Soviet programs that correspond to those funded and conducted in the US by NASA are considered to be civil and those which correspond to programs funded by the Department of Defense are considered to be military. The estimated outlays for these civil and military space programs--with the exception of those for the RDT&E phases of military space programs--are summed, converted to rubles, and then subtracted from the total for military RDT&E and space. The result is a ruble estimate of Soviet spending for military RDT&E which includes RDT&E spending for military space systems, but excludes spending for operating military space systems.

Price Adjustments

The next step in the methodology is to adjust the ruble data to a constant price base so that estimated annual changes in expenditure levels will reflect only changes in the underlying level of activity and not any changes in prices.

The Soviets introduced a major price revision in mid-1967--the first overall change in the Soviet wholesale price structure since 1955. The Office of Strategic Research estimates, on the basis of information received to date, that this price revision and subsequent adjustments had the effect of increasing R&D costs by about 6 percent through 1969. The published Soviet "science" expenditure data have therefore been adjusted to reflect this price change and the results of this adjustment are characterized in this report as being in constant 1968 rubles.

Finally, all of the ruble data derived by the procedures described above are converted to dollar estimates by applying ruble-dollar ratios developed by the Office of Strategic Research specifically for R&D activity. (See the discussion beginning on page 18.)

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Table 1
Announced Soviet "Science" Expenditures and Related Indicators

	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
Total announced expenditures (billion current rubles)	3.9	4.5	5.2	5.8	6.4	6.9	7.5	8.2	9.0	10.0
Indicators										
Wage bill for science and science services ^a (billion current rubles)	2.20	2.54	2.87	3.12	3.36	3.64	3.90	4.24	4.64	4.98
Scientists (thousands)	138.7	158.2	172.9	190.7	200.7	214.1	231.9	246.0	262.6	277.8
Total engineers in civilian economy (thousands)	1,135	1,236	1,325	1,421	1,498	1,631	1,734	1,789	1,960	2,107
Research institutes, their branches and departments	1,729	1,832	1,911	1,976	2,019	2,084	2,160	2,236 ^b	2,313 ^b	2,388

a. Calculated from published Soviet data on average wages and employment in science and science services.
b. Interpolated.

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Reliability of the Ruble Estimates

There is no precise method for confirming the accuracy of the estimates derived by the methodology described above. There are, however, some aggregate measures available for checking the reasonableness of the estimates of Soviet R&D spending--particularly with respect to trends.

The rate of growth in announced Soviet scientific and technical manpower over the past 10 years has exhibited the same general trend as announced total "science" expenditures. A wage bill for science and science services--calculated on the basis of published manpower and salary data--also parallels the growth in total "science" expenditures over this period. Similarly, there has been substantial growth in the number of scientific research institutes in the USSR since 1960. Taken together, these indicators lend credibility to estimates of rapid growth in R&D spending based on data announced by the USSR since 1960.

To check the reliability of the announced statistics on Soviet "science" expenditures, several data series representing different aspects of the R&D environment were investigated. Statistical correlation analysis was conducted between the announced total "science" expenditures and each of four other R&D related series derived from published Soviet statistics--the number of scientists, the number of engineers, the number of scientific research institutes, and a wage bill series calculated on the basis of published Soviet scientific employment and salary information (see Table 1).

These statistical tests show that there is a high degree of internal consistency between each of the indicators and the reported total "science" expenditures, lending strong support to the conclusion that the announced total is a valid indication of the trend in the Soviet scientific effort.

In addition to supporting the validity of the trend in total expenditures, the calculated wage bill also serves as a rough check on the level of reported

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total "science" expenditures. An article in the July 1970 issue of *Finansy SSSR*--the official organ of the Soviet Ministry of Finance--dealing with the financial aspects of scientific research noted that "wages make up approximately 50 percent" of the expenses of "carrying out scientific research for the nation as a whole." The fact that the calculated wage bill amounts to about 50 percent of total "science" expenditures in the 1960-1970 period supports the conclusion that the published Soviet totals for "science" expenditures probably do include all science--that is, R&D--expenditures.

In spite of these checks, however, the methodology still is limited by its dependence on the Soviets' intention and capability to report accurately. Although published expenditure data have frequently contained discontinuities and elements of confusion that have taken considerable time and effort to unravel, there has been no indication that the numbers were falsified. The Soviet practice over the years has been to withhold data or to confuse with ambiguous or even changing definitions, rather than to falsify.*

The uncertainty of these estimates is greater for recent years. Whereas for the earlier years US monitoring of weapons R&D and space programs provides some independent information on the trend and levels of effort, the time lag between early R&D activities and later phases such as testing makes such monitoring observations incomplete since about 1968. The estimate for 1970 is particularly tenuous for this reason, and also because 1970 budget information has not yet become available. The estimates for the last two years should be regarded as preliminary and subject to revision.

Another form of indirect and incomplete evidence of growth trends in high priority areas of Soviet R&D is found in the book *Economic Problems of the Effectiveness*

* The assumption that the Soviets inadvertently revealed the magnitude and trend of their budget expenditures for "classified" activities in the 1958 handbook was given support by a 1962 edition of the same handbook which was identical in coverage to the 1958 edition with the single exception that it omitted the table with the unexplained residual.

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of Science, published in 1971 by an organ of the Central Committee of the Communist Party. This source contains information on R&D expenditures during the period 1955-1968 by four major branches of Soviet industry--general machinebuilding, electrotechnical, radioelectronic, and instrumentmaking--known to be heavily involved in military and space programs* as well as civil R&D in fields of top priority Soviet interest. Although there is some ambiguity in exactly what the reported R&D expenditures of these industries cover, the growth in the reported total for the four industries corresponds well with the growth in estimated military RDT&E and space expenditures. This does not directly support any particular level of military R&D and space expenditures. It does, however, support the fact that growth rates in some areas of Soviet R&D--in priority civil fields as well as in military and space activity--may be substantially above the average growth for science as a whole. Further analysis of these data is required, however, before their full meaning can be understood.

The separate expenditure estimate for space relies heavily on the monitoring capabilities of US intelligence. The intelligence coverage of those aspects of the Soviet space program most responsible for determining costs--missions, time phasing, test facilities, launch vehicles, other hardware, etc.--is excellent. This coverage makes it possible to use the direct costing technique for estimating Soviet space expenditures.

Because the estimate of military RDT&E expenditures is calculated by subtracting space program costs (with the exception of those for military space systems RDT&E) from the combined total for military RDT&E and space, it too is dependent, at least indirectly, on the quality of US intelligence monitoring capabilities. It is also affected by uncertainties of the dollar costing procedures and of the estimated

* *These branches, for example, probably perform the R&D on avionics, guidance systems, radars, and communications equipment for the Ministry of Defense. They would not be responsible for R&D on propulsion systems and airframes for missiles and aircraft as well as R&D on other weapons, military vehicles, and naval vessels.*

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conversion ratio by which the space program costs are converted to rubles.

In sum, the Office of Strategic Research believes that the estimates of Soviet spending for R&D and space activities--expressed in ruble values--are a reasonably accurate representation of the Soviet effort in terms of both trends and absolute levels of spending, although less confidence can be attached to the breakdown among civil R&D, military RDT&E, and space.

Ruble-Dollar Conversions

To provide an appreciation of the magnitude of the Soviet R&D program the ruble estimates are converted to dollar values, the validity of which is critically dependent upon the accuracy of the ruble-dollar ratio used. Conceptually the ratio should quantify precisely the outlays required in the US and in the USSR to achieve a given R&D product. Unfortunately, no one has yet devised a satisfactory means of measuring--or even defining--the output of the R&D sector.

R&D output can be viewed in several ways, and some of the "products" are more quantifiable than others, although clearly none can be measured precisely. The product of theoretical research is usually considered to be new knowledge, while the end result of applied research and development is commonly viewed as the design and construction of prototype models of equipment. Finally, at the most general level, the technology embodied in operational equipment represents the useful output of the entire R&D process.

Looking at the product of the Soviet R&D effort in this last, most general sense makes it clear that conversion at the official rate of exchange of 90 rubles to 100 dollars would grossly understate the dollar outlays required to reproduce the Soviet R&D product in the US. Accordingly, the official rate of exchange is useful only in that it helps to define the upper limit to a value for an appropriate ruble-dollar ratio for the R&D sector--by identifying a value that

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is clearly too high. (The higher the ruble-dollar ratio, the lower the dollar outlay implied.)

The lower limit for a reasonable ruble-dollar ratio has been established in another way. If the resource inputs--that is, manpower, capital equipment, and materials--to the US and Soviet R&D efforts were identical in their composition and quality, and if these resources were organized and managed with equal efficiency in the two countries, then one unit of physical input--defined as one scientific worker and all of the equipment, facilities, material, and management that go with him--would result in an equal level of output in the two countries. Measurement of R&D product becomes unnecessary because inputs, which can be measured and priced, could be used as a legitimate proxy for outputs and would provide the appropriate ratio for valuing one country's R&D product (total cost of inputs) in the other country's currency.

Direct pricing of Soviet and US R&D input units produces a ruble-dollar ratio of about 35 rubles to 100 dollars. The application of this ratio to the ruble estimates, however, would overstate the outlays required in the US to reproduce the Soviet R&D product, because the Soviet R&D input unit is clearly less productive than the counterpart US input unit. This judgment is based on Soviet acknowledgments of lower productivity, and on the observations of US specialists who have visited and examined the operation of Soviet laboratories and other scientific establishments. The input ratio of 35 rubles to 100 dollars, therefore, defines the lower limit to a reasonable value for the ruble-dollar ratio for the R&D sector.

A 1966 article by a leading Soviet scientist and R&D manager, Peter Kapitsa, helps to quantify the productivity differential and thereby narrows the range of reasonable ruble-dollar ratios. Kapitsa acknowledged the difficulty of measuring scientific productivity, but quoted approvingly the results of an unidentified US study and noted that:

...one must conclude that we produce half the scientific output produced by the

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Americans with nearly the same number of scientists. It must be inferred, therefore, that the productivity of our scientists is lower than that of scientists in the US. (*Komsomolskaya Pravda*, 20 January 1966)

Taken at face value, this statement suggests that the computed input cost ratio of 35 rubles to 100 dollars should be adjusted upward to nearly 70 rubles to 100 dollars. This would, however, represent an overly harsh judgment on Soviet R&D productivity. The context of Kapitsa's article--exhorting greater efforts by the Soviet scientific community--suggests that he would have tended to exaggerate the differential. Even Kapitsa did not carry his reasoning so far as to state flatly that the productivity of Soviet science was half that of the US.

The lower productivity attributed to the Soviet R&D input unit is not based on the judgment that Soviet scientists and engineers are less competent overall than their US counterparts. Rather, they are not able to produce as much output because they have less capital equipment to work with--for example, the extensive computer facilities that support the US scientist and engineer are simply not available to the Soviets. Moreover, by all reports--both from the Soviets themselves and Western observers--the Soviet scientist works in a less effective managerial environment, particularly with respect to the adoption and implementation of new technology. From all reports this applies to both military and civil fields, but is particularly true in civil R&D programs.

These considerations have led the Office of Strategic Research to select differential ruble-dollar ratios of 60 rubles to 100 dollars for the civil R&D sector and 50 rubles to 100 dollars for the military RDT&E and space sectors. Compared with the input ratio of 35 rubles to 100 dollars, these ratios imply that the US is about 40 percent more efficient than the USSR in military and space research and development activities and about 70 percent more efficient in civil R&D.

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Viewed from the Soviet side, the military RDT&E and space effort is more efficient than the civil R&D effort--a reflection of the clear priority the Soviets give to defense and space in the allocation of equipment, materials, and managerial talent.

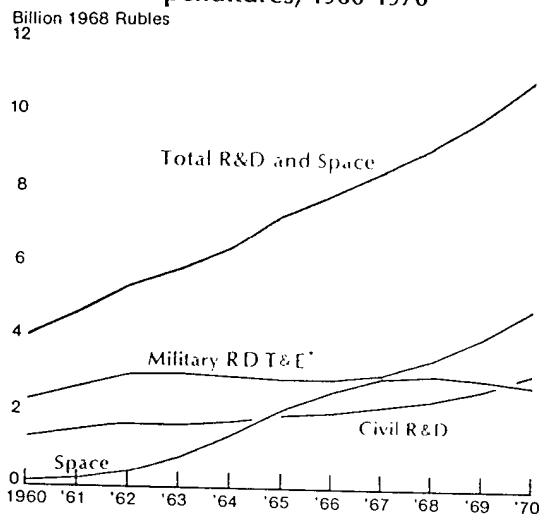
As noted above, there is no way to measure the products of R&D activity with precision. Therefore, there is no way to test precisely the validity of the productivity adjustments or the resulting ruble-dollar ratios. For this reason, the estimated dollar values of Soviet R&D activity in this report should be viewed as approximations rather than precise measures.

Trends in Spending

Ruble Estimates

The Soviets maintained an active military RDT&E effort throughout the Sixties, although the strong upsurge in space spending in the middle of the decade is believed to have been accompanied by a temporary, slight reduction of expenditures for military RDT&E during 1964-1967. (See chart below and Table 2, next page.) By 1970 the estimated spending level for military RDT&E--including

Estimated Soviet R&D and Space
Expenditures, 1960-1970



* Covers all military systems RDT&E including military space systems and all nuclear energy RDT&E. Outlays for members of active military forces assigned to RDT&E activities as well as for civilian personnel employed in such activities are included.

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Table 2

Estimated Soviet R&D and Space Expenditures, 1960-1970 *a*

	Billion 1968 Rubles										
	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
Military RDT&E <i>b</i>	<u>2.42</u>	<u>2.81</u>	<u>3.16</u>	<u>3.20</u>	<u>3.09</u>	<u>3.03</u>	<u>3.04</u>	<u>3.15</u>	<u>3.57</u>	<u>4.15</u>	<u>4.89</u>
Of which:											
Military space RDT&E	0.03	0.12	0.17	0.11	0.14	0.14	0.18	0.21	0.27	0.46	0.62
Space	<u>0.24</u>	<u>0.33</u>	<u>0.56</u>	<u>0.95</u>	<u>1.54</u>	<u>2.24</u>	<u>2.75</u>	<u>3.05</u>	<u>3.13</u>	<u>3.05</u>	<u>2.89</u>
Civil space	0.24	0.33	0.56	0.87	1.42	2.04	2.49	2.75	2.77	2.68	2.53
Military space operations	0	0	0	0.08	0.12	0.20	0.26	0.30	0.36	0.37	0.36
Civil R&D	<u>1.48</u>	<u>1.64</u>	<u>1.80</u>	<u>1.80</u>	<u>1.86</u>	<u>2.06</u>	<u>2.19</u>	<u>2.33</u>	<u>2.49</u>	<u>2.80</u>	<u>3.17</u>
Total R&D and space	<u>4.14</u>	<u>4.78</u>	<u>5.52</u>	<u>5.96</u>	<u>6.48</u>	<u>7.33</u>	<u>7.96</u>	<u>8.54</u>	<u>9.18</u>	<u>10.00</u>	<u>10.95</u>

a. Because of rounding, components may not add to totals shown.*b.* Covers all military systems RDT&E including military space systems and all nuclear energy RDT&E. Outlays for members of active military forces assigned to RDT&E activities as well as for civilian personnel employed in such activities are included.

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RDT&E for military space systems--of about 4.9 billion rubles was about twice the 2.4 billion rubles estimated to have been spent in 1960. The annual rate of growth in military RDT&E spending between 1960 and 1970 in constant 1968 rubles averaged 7 percent.

In terms of total spending on R&D and space during the Sixties, military RDT&E is estimated to have declined somewhat in relative importance. In 1960, military RDT&E expenditures accounted for an estimated 58 percent of total R&D and space spending. At that time civil R&D accounted for about 36 percent of the total and the fledgling civil space program only about 6 percent. The military RDT&E share declined steadily to a low of about 37 percent in 1967, with civil R&D at 27 percent and the space share (excluding military space RDT&E) at a peak of 36 percent. Since 1967 the share of military RDT&E has increased and in 1970 accounted for about 45 percent.

Between 1960 and 1967 military RDT&E expenditures amounted to about 16 to 18 percent of total Soviet defense expenditures. Since 1967, spending on military RDT&E has been increasing and accounted for about 23 percent of the total Soviet defense bill in 1970.

The growth in spending for military RDT&E compared with that for weapons procurement during the Sixties emphasizes Soviet willingness to forgo additional current hardware procurement for the development of improved future weapons systems. Compared with expenditures for hardware procurement, military RDT&E spending was about half as much in 1960 but by 1970 had grown to 80 percent as much.

Dollar Valuations

Dollar valuations of Soviet R&D are designed to provide an appreciation of the level of activity--measured in dollars--that would be required to reproduce the Soviet effort in the US. The dollar estimates provide a basis for approximate comparisons with US spending for equivalent activities.

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Table 3
Dollar Valuation of Estimated Soviet R&D and Space Expenditures,
1960-1970 ^a

	Billion 1968 Dollars										
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Military RDT&E ^b	4.84	5.61	6.30	6.39	6.16	6.06	6.06	6.30	7.13	8.29	9.78
Of which:											
Military space RDT&E	0.06	0.23	0.33	0.22	0.27	0.29	0.35	0.42	0.54	0.91	1.24
Space	0.47	0.66	1.12	1.91	3.07	4.48	5.48	6.11	6.25	6.10	5.78
Civil space	0.47	0.66	1.12	1.74	2.83	4.08	4.97	5.50	5.54	5.36	5.07
Military space operations	0	0	0	0.17	0.24	0.40	0.51	0.61	0.71	0.74	0.71
Civil R&D	2.48	2.75	3.01	3.01	3.10	3.43	3.66	3.89	4.15	4.67	5.28
Total R&D and space	7.79	9.02	10.43	11.31	12.33	13.97	15.20	16.30	17.53	19.07	20.84

a. Because of rounding, components may not add to totals shown.

b. Covers all military systems RDT&E including military space systems and all nuclear energy RDT&E. Outlays for members of active military forces assigned to RDT&E activities as well as for civilian personnel employed in such activities are included.

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It is estimated that the Soviets spent the equivalent of about \$73 billion for military RDT&E from 1960 through 1970 (see Table 3). The estimated annual rate of expenditures rose from the equivalent of almost \$5 billion in 1960 to the equivalent of almost \$6.4 billion in 1963. It declined slightly through 1966, but began increasing after that and in 1970 reached the equivalent of about \$9.8 billion.

And it is important to note that the relative levels of military RDT&E efforts of the US and USSR--as measured in dollar terms--cannot be considered a reliable guide to the current or future effectiveness of US and Soviet military technology. The Soviet space program, for example, is the largest in the world in terms of expenditures, but it has not approached the US level of technical sophistication and capabilities. In military RDT&E, the Soviets are buying today in many areas what the US bought a number of years ago. In short, expenditures do not equate to capabilities, and nowhere is this caution more likely to have more significance than in R&D activities.

It is clear, nevertheless, that the Soviets are increasing the resources devoted to military RDT&E. The level of resource allocation is obviously related to the product of the RDT&E process, so that it is important to understand the general magnitude of the Soviet commitment. The Soviet effort is cast in dollar terms not as a means of judging the relative positions of the US and the USSR in advanced military technology, but for the purpose of providing a meaningful basis for understanding the magnitude of military RDT&E activity in the US and the Soviet Union--an understanding that would not be possible if US and Soviet expenditures were not expressed in a common currency. A comprehensive assessment of the state of Soviet military technology vis-a-vis the US, however, cannot be made solely on the basis of expenditure comparisons.

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